DOUBLE MOLD MEMORY CARD AND ITS MANUFACTURING METHOD

INVENTORS

Chul Woo Park
Suk Gu Ko
Sang Jae Jang
Sung Su Park
Choon Heung Lee

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] Not Applicable

STATEMENT RE: FEDERALLY SPONSORED RESEARCH/DEVELOPMENT

[0002] Not Applicable

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0003] The present invention relates generally to memory cards, and more particularly to a memory card (e.g., a multi-media card (MMC)) which is fabricated through the implementation of a two-stage molding process.

2. Description of the Related Art

[0004] As is well known in the electronics industry, memory cards are being used in increasing numbers to provide memory storage and other electronic functions for devices such as digital cameras, MP3 players, cellular phones, and personal digital assistants. In this regard, memory cards are provided in various formats, including multi-media cards and secure digital cards.

[0005] Typically, memory cards include multiple electronic components such as integrated circuit devices, semiconductor dies, passive components, and the like. The components are often interconnected using a circuit board substrate. Memory cards also include electrical contacts or terminals for providing an external interface to an insertion point or socket. These electrical contacts are typically disposed on one side or face of the circuit board substrate, with the

electrical connection to the components mounted to the substrate being provided by conductive vias and traces which extend through and along the substrate.

[0006] In certain memory cards, a leadframe assembly is used as an alternative to the circuit board substrate, as is described in Applicant's co-pending U.S. Application Serial No. 09/956,190 entitled LEAD-FRAME METHOD AND ASSEMBLY FOR INTERCONNECTING CIRCUITS WITHIN A CIRCUIT MODULE filed September 19, 2001.

[0007] In those memory card configurations which in employ the use of the above-described substrate having one or more electrical devices or components mounted thereto, such components are typically covered or protected by a cap or lid (sometimes referred to as a "skin") which is separately fabricated and attached to the substrate. The cap is typically fabricated through the implementation of an injection molding process, and is subsequently adhesively secured to the substrate in a manner covering or shielding the components mounted thereto. The cap is typically fabricated such that when mounted to the substrate, the resultant memory card meets or achieves a desired a desired "form factor." As will be recognized, the requirement of separately fabricating the cap significantly increases the manufacturing cost for the prior art memory card, in addition to decreasing yield rate due to the need to carry out a separate process or step to mechanically couple the cap to the substrate. This separate coupling process also increases the susceptibility of the internal components mounted to the substrate of being contaminated with various particles. The present invention addresses and overcomes these deficiencies of currently known memory cards by providing a memory card wherein the cap or lid is eliminated in favor of a two-stage molding process, These and other attributes of the present invention will be described in more detail below.

BRIEF SUMMARY OF THE INVENTION

[0008] In accordance with the present invention, there is provided a double mold memory card wherein first and second encapsulation parts are separately formed on a substrate, and used as an alternative to a conventional cap or lid. The first and second encapsulation parts are formed via the implementation of a two stage molding process wherein the first encapsulation part is initially formed on a surface of the substrate of the memory card including the conductive contacts or terminals thereof, which is followed by the formation of a second encapsulation part on an opposed surface of the substrate having one or more electrical components mounted

thereto and electrically connected to the terminals of the substrate. As such, the second encapsulation part effectively covers or encapsulates the component(s) of the memory card. The elimination of the separate cap or lid lowers manufacturing costs while increasing yield rate.

[0009] The present invention is best understood by reference to the following detailed description when read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] These, as well as other features of the present invention, will become more apparent upon reference to the drawings wherein:

[0011] Figure 1A is a top plan view of a memory card constructed in accordance with the present invention:

[0012] Figure 1B is a bottom plan view of the memory card shown in Figure 1A;

[0013] Figure 1C is a cross-sectional view of the memory card of the present invention taken along line 1-1 of Figure 1A; and

[0014] Figures 2A-2E illustrate an exemplary sequence of steps which may be used to facilitate the fabrication of the memory card shown in Figures 1A-1C.

[0015] Common reference numerals are used throughout the drawings and detailed description to indicate like elements.

DETAILED DESCRIPTION OF THE INVENTION

[0016] Referring now to the drawings wherein the showings are for purposes of illustrating a preferred embodiment of the present invention only, and not for purposes of limiting the same, Figures 1A-1C depict a memory card 100 constructed in accordance with the present invention. The memory card 100 comprises a substrate 110 which defines a generally planar top surface 111 and an opposed, generally planar bottom surface 112. Disposed on the bottom surface 112 of the substrate 110 in relative close proximity to one of the peripheral edge segments thereof is a plurality of contacts or terminals 113. As will be recognized, the terminals 113 are used to facilitate the electrical connection of the memory card 100 to an external device. Thus, in addition to being exposed in the memory card 100 as will be described in more detail below, the terminals 113 are oriented so as to be placeable into electrical communication with

corresponding pins of a host socket connector into which the memory card 100 is completely or partially advanced. The substrate 110 may comprise a rigid printed circuit board (PCB), a flexible PCB, a leadframe, or a similar suitable structure. Those of ordinary skill in the art will recognize that the present invention is not limited to any particular material for the substrate 110.

[0017] Mounted to the top surface 111 of the substrate 110 is a plurality of semiconductor parts or electronic components 120. As shown in Figure 1C, the depicted components 120 include at least one semiconductor package 121, at least one semiconductor die 122, and at least one passive component 123. In the memory card 100, the components 120 are electrically connected to the substrate 110 and more particularly to the terminals 113 included on the bottom surface 112 thereof. More particularly, it is contemplated that the substrate 110 will be provided with conductive vias and traces which extend therethrough and therealong in any pattern as needed to accommodate the component(s) 120 included in the memory card 100. As further seen in Figure 1C, the semiconductor package 121 and the passive component 123 are surface-mounted to the top surface 111 of the substrate 110 and to the conductive traces which facilitate the electrical connection to the terminals 113. The semiconductor die 122 is shown as being electrically connected to the conductive traces of the substrate 110 through the use of conductive wires 124.

[0018] Those of ordinary skill in the art will recognize that the type, number and arrangement of components 120 shown in Figure 1C is exemplary only, in that one component 120 or multiple components 120 of any type may be mounted and electrically connected to the substrate 110 in any number, combination or pattern depending on the desired application for the memory card 100. All that is necessary is that the substrate 110 be configured to facilitate the electrical communication between any component(s) 120 and the terminals 113. Along these lines, the number of terminals 113 included on the substrate 110 in the memory card 100 is also variable, in that the number of terminals 113 may be varied according to the particular application for the memory card 100.

[0019] In addition to the substrate and components 120, the memory card 100 comprises a first encapsulation part 130 which is formed on the bottom surface 112 of the substrate 110. As seen in Figures 1B and 1C, the first encapsulation part 130 is preferably formed to be of substantially uniform thickness, and includes an opening or slot 131 formed in a predetermined area thereof. More particularly, the slot 131 is disposed in and extends inwardly from one

peripheral edge segment of the first encapsulation part 130, the slot 131 being oriented so as to facilitate the exposure of the terminals 113 when the first encapsulation part 130 is formed on the bottom surface 112 of the substrate 110. The first encapsulation part 130 effectively protects the substrate 110 from the external environment, and enhances the overall rigidity of the memory card 100 as will be discussed in more detail below. The first encapsulation part 130 may be formed from an epoxy mold compound, and may be fabricated by filling or injecting such epoxy mold compound into a mold after placing the substrate 110 into a suitably shaped mold cavity of the mold.

[0020] In addition to the first encapsulation part 130, the memory card 100 includes a second encapsulation part 140 which is formed on the top surface 111 of the substrate 110. Like the first encapsulation part 130, the second encapsulation part 140 is preferably formed to be of uniform thickness, and is adapted to protect the components 120 from the external environment. Since the second encapsulation part 140 effectively covers or encapsulates the components 120, the second encapsulation part 140 is significantly thicker than the first encapsulation part 130. The second encapsulation part 140 is also preferably formed from an epoxy mold compound, and is fabricated by filling or injecting such epoxy mold compound into a mold after placing the substrate 110 into a suitably shaped mold cavity thereof.

[0021] As seen in Figures 1A and 1C, the second encapsulation part 140 is preferably formed to include a notch 141 of predetermined depth within each of an opposed pair of sides or peripheral edge segments thereof. The opposed notches 141 within the second encapsulation part 140 are used to facilitate the coupling of the memory card 100 to an external device. Also, the second encapsulation part 140 is also preferably formed to include an opposed pair of elongate guide slots or openings 142 within respective ones of an opposed pair of sides or peripheral edge segments thereof. The guide openings 142 preferably extend in spaced, generally parallel relation to the elongate terminals 113 of the substrate 110, and are used to assist in guiding the memory card 100 into an external device. Also formed in the second encapsulation part 140 is a slot 143 of predetermined depth. Slot 143 is formed in close proximity to that side or peripheral edge segment of the second encapsulation part 140 which is disposed furthest from the terminals 113 of the substrate 110. The slot 143 is used to assist in the removal of the memory card 100 from an external device. Those of ordinary skill in the art will recognize that the shapes and locations of the notches 141, the guide openings 142, and the slot

143 can be varied according to the configuration of the external device with which the memory card 100 is to be used. Additionally, the shapes of the first and second encapsulation parts 130, 140 may be varied from that shown in Figures 1A-1C depending on the desired form factor for the memory card 100.

[0022] Referring now to Figures 2A-2E, there is shown an exemplary sequence of steps which may be used to facilitate the fabrication of the memory card 100 of the present invention. The initial step of the fabrication method comprises providing the substrate 110 having the above-described structural attributes (Figure 2A). As shown in Figure 2A, multiple substrates 110 are initially interconnected to each other in a common strip or structure. Thereafter, a first encapsulation part 130 having the above-described structural attributes is formed on the bottom surface 112 of each substrate 110 (Figure 2B). As is seen in Figure 2B, each first encapsulation part 130 is formed such that the terminals 113 of the corresponding substrate 110 are not covered thereby. Additionally, the first encapsulation parts 130 are not integrally connected to each other, but are disposed in spaced relation to each other on the strip including the multiple substrates 110.

[0023] Subsequent to the formation of the first encapsulation parts 130, the component(s) 120 are mounted and electrically connected to each of the substrates 110 in the above-described manner (Figure 2C). Thereafter, a second encapsulation part 140 is formed on the top surface 111 of each substrate 110 in the above-described manner to cover or encapsulate the components(s) 120 mounted and electrically connected to the substrate 110 (Figure 2D). Finally, a singulation step is completed to effectively separate the fully formed memory cards 100 from each other (Figure 2E). As shown in Figure 2E, a predetermined area of the strip including the substrates 110 is sawed or cut to facilitate the formation of the individual double mold memory cards 100 of the present invention, each fully formed memory card 100 including a substrate 110, the component(s) 120 mounted and electrically connected to the substrate 110, the first encapsulation part 130, and the second encapsulation part 140. Those of ordinary skill in the art will recognize that the fabrication steps described above are equally applicable to forming a memory card 100 from a single substrate 110, as opposed to simultaneously fabricating multiple memory cards 100 from multiple substrates 110 integrally connected to each other in a single strip which is ultimately cut or singulated in the above-manner.

[0024] This disclosure provides exemplary embodiments of the present invention. The scope of the present invention is not limited by these exemplary embodiments. Numerous variations, whether explicitly provided for by the specification or implied by the specification, such as variations in structure, dimension, type of material and manufacturing process, may be implemented by one of skill in the art in view of this disclosure.